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A Comparison of Cognitive Approaches to Increasing Pain Tolerance

by

© Judith Emily Beach

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Abstract

Eighty subjects were randomly assigned to one of four treatments: cognitive coping skills, sensation information, emotional processing, or a placebo-control, in order to test the relative effects of the treatments on pain tolerance, distress, and discomfort. Pain tolerance was defined as the length of time subjects were able to keep their hands immersed in ice-cold water (the cold pressor test).

The cognitive coping skills treatment consisted of instruction in covert cognitive skills relevant to withstanding painful stimulation, and it closely resembled a portion of Meichenbaum's stress inoculation procedure. The sensation information treatment was based on Leventhal's model, and provided information about the physical sensations which could be anticipated during the cold pressor test, in order to facilitate objective processing. The emotional processing treatment was based on the converse of the objective processing treatment, and was designed to encourage subjects to process the sensations in an emotional manner. The placebo consisted of a neutral reading about reactions to cold. The three treatment groups each completed the cold pressor test after listening to the treatment. The control subjects completed the cold pressor test twice: once with no treatment, and once following the placebo. Ratings on a Likert-style scale were also obtained from subjects on the following variables: distress and discomfort experienced during the cold pressor test, self-efficacy expectations, expected effectiveness of treatment, helpfulness of treatment, extent of use of treatment, and thoughts regarding injury. Each subject was also interviewed.

The results indicated that each of the treatments was significantly more effective in increasing pain tolerance compared to the no-treatment control. The treatments were no more effective than the placebo, however. Contrary to predictions based on Leventhal's hypothesis, the emotional processing treatment was as effective as the objective processing treatment. All of the treatments increased pain tolerance, but did not affect subjects' reported distress and discomfort. Subjects across all treatments who expressed that they expected that the treatments would be helpful obtained higher pain tolerance scores and reported less discomfort and distress. The results indicated no relationship between subjects' confidence in their own ability and pain tolerance, distress, and discomfort.

The results were discussed within the context of recent research, and suggestions for further research and applications in therapy were offered.

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I. INTRODUCTION

Pain is a very complex expenience which is familiar to virtually everyone. Although pain is typically thought of as a sensory experience, in fact, there is a broad range of influences which can change the experience of pain, in different situations and in different individuals. For example, a football player might withstand considerable abuse on the playing field and not be aware of any pain, yet find a visit to the dentist very uncomfortable and distressing.

If the alteration of the experience of pain can be better understood, then effective methods of helping people to cope with pain can be developed.

A number of promising nonsurgical and nonpharmacological approaches to helping people to alter their experience of pain have been developed recently. Of particular interest in this study were methods of psychologically preparing people to deal with pain. Such approaches are important because, as has been recognized for a long time, the psychological state of a person significantly affects not only the course of medical treatment, but his day-to-day well-being. The most obvious use of findings from a study dealing with pain would be to apply them to cases of acute pain, as an adjunct to or replacement for medical treatments. However, people are confronted with pain on a day-to-day basis as well, ranging from discomfort from physical exertion to pain from minor injuries. An understanding of how individuals deal with pain and the associated stress also provide insight into the mechanisms underlying people's coping with a wide variety of stressful situations. The techniques based on this understanding could be further refined to help people to prepare for and cope with a number of stressful situations.

The general purpose of this study was to investigate the effects of cognitive approaches to changing tolerance of pain. That is, the main question which was posed was: "Does the person's acquisition of particular types of information and strategies affect his or her capacity to tolerate pain?"

In order to investigate this question, an analogue study was employed. An analogue study is designed to evaluate aspects of treatment under laboratory conditions which are set up to resemble the clinical situation. The advantage of such a study is that it allows analysis and control of the conditions of experimentation to an extent which might not be practical, possible, or ethical in a clinical setting.

For example, the intended contribution of this study was to develop effective methods of helping people to prepare for episodes of acute pain. The use of analogue research in this case was appropriate because the pain stimulus could be standardized. That is, every subject received the same stimulus under the same conditions. Such control helps to minimize the possibilities of explanations for the results other than the effects of the treatments under scrutiny. In a clinical setting, it would be difficult first, to determine the similarity of pain experienced by subjects, and second, to exclude other influences on how pain is experienced.

There are some limitations on the external validity of the findings of this study. That is, it is difficult to determine the extent of the generalizabilty of the results obtained from subjects who volunteered to expose themselves to the pain stimulus to patients experiencing acute pain in a clinical setting. In addition, the similarity of the particular experience of exposure to cold water to pain experienced on a day-to-day basis or in a clinical situation is not known.

The use of an analogue in this study, however, fulfilled the purpose of the study; that is, to assess the relative effects of three cognitive approaches to modulating pain.

A brief overview of the study is presented here. In investigating the research questions already posed, the laboratory analogue of pain was the exposure of subjects' hands to ice-cold water. The major intent of the experiment was to determine whether providing different types of information to the subjects would affect their capacity to tolerate the pain. Hence, the subjects were divided into four groups, each receiving different information before being exposed to the painful stimulation. The four treatments the subjects received were: (a) instruction in cognitive coping skills, (b) objective information about the sensations which could be expected from exposure to cold water, (c) information intended to increase fearful expectations about pain, and (d) a placebo. The subjects in the placebo group also completed the pain test without any preparation, in order to provide a basis for comparison.

The treatments are described in detail in Chapter II, and in Chapter III, the method employed in this study is outlined. The results, which are presented and discussed in Chapters IV and V, suggested that all of the treatments were equally effective in increasing pain tolerance.

The purpose of this chapter has been to introduce this study by providing an overview of its main purpose and a brief description of how it was conducted. In the next chapter, the literature related to the topic of this study is reviewed.

II. REVIEW OF RELATED LITERATURE

This review of literature has four purposes. First, the model of pain implicit in this study is clarified. Second, the literature pertinent to the specific areas of interest in this study is discussed. Third, the trends in the literature which led to the formulation of this study are identified, and fourth, the main questions which were addressed in this study are specified.

A. Defining Pain

Although the popular notion of pain is that of a simple sensory process, further consideration reveals that it is in fact a very complex phenomenon. Numerous factors interact to determine an individual's experience of pain, and these are examined here through the consideration of the major models which have been used to explain pain.

Pain defined as a unidimensional phenomenon has been the traditional and most popular conceptualization (Turk, 1978). Leventhal and Everhart (1979) have discussed the sensory and the additive models, which they described as unidimensional. In the sensory model, pain is considered to be a product of a sensory system: a particular type of external stimulus acts upon specialized receptors, which then transmit signals to "pain centers" in the brain. The implication of such a model is that pain necessarily means injury, and the greater the injury, the greater the pain. Exceptions to this model are easily found, hence recently it has been generally considered inadequate. For example, in Beecher's (1946) classic study, over half of the men wounded in battle reported no pain or only slight pain from their wounds, yet many of them complained about the pain from simple injections. These findings indicated that a model of pain must attempt to account for determinants other than only the sensory components.

Based on his findings, Beecher (1965) proposed an additive model. Briefly, this model suggests that the physical stimulus brings about pain through the sensory system, and then an affective response or fear reaction is added on. Findings of recent studies which have been reviewed by Leventhal and Everhart have suggested that emotional distress should not be viewed as a separate component which is added on to the sensory experience of pain. Briefly, this conclusion centered on evidence that psychological factors can produce changes in sensory pain, and that individual differences and situational variations influence both emotional reactions and sensory pain.

In spite of the criticism which has been levelled at the unidimensional models based on simple sensory processes, they continue to be used as the foundation of some medical models of illness, and therefore of treatment approaches (Leventhal & Everhart, 1979; Turk, 1978). The implication is that to stop pain, all that is needed is an interruption of the pain pathway, which accounts, to some extent, for the popularity of treatments such as pharmacological agents which act at various sites in the nervous system, and a variety of surgical procedures which often produce questionable results (Weisenberg, 1977).

Recent references (Hilgard & Hilgard, 1975; Leventhal & Everhart, 1979; Turk, 1978) indicated general agreement that a multidimensional model is needed to adequately explain the complex experience of pain. The most influential theory in the development of such an approach has been the gate-control theory (Melzack & Wall, 1965; Melzack, 1973). Briefly, this theory proposes two neural systems which conduct impulses from the spinal cord to the higher centers of the brain. The sensory-discriminative system carries information such as the location and intensity of the stimulation, while the motivational-affective system carries information about the aversive qualities of the stimulation, or suffering. These two components are initiated simultaneously and are processed separately. The systems correspond to large and small fibres entering the spinal cord, and these interact to produce the pain information which goes to the higher centers of the brain. The "gate" refers to a mechanism which modulates sensory input by the balance of activity in the large and small fibres. Activity of large fibres closes the gate; activity of small fibres opens the gate. A central control process (the cognitive-evaluative system) can either open or close the gate. Hence, there are a number of ways in which activity in the spinal cord can be modified. For example, modification of cognitive processes, such as maladaptive beliefs or expectations, could function to close the gate and thereby reduce painful input.

Although the claims regarding the neurological bases of gate-control theory have not gone uncriticized (Nathan, 1976), it has greatly influenced research on pain management. The concept that pain has two components, sensory pain and suffering, was accepted some time ago, as in the additive model already discussed. However, the idea that these components represent separate and simultaneously-activated systems was the innovation of Melzack and his colleagues. Gate-control theory has had significant impact on pain research because it ascribes considerable weight to the psychological influences on pain perception.

In summary, a survey of the literature on models of pain suggests two things: that there are a number of ways of conceptualizing the experience of pain, and that in order to be useful, a model must account for the complexity of pain. The general area of interest in this study was the role of psychological factors in pain, a topic which has been introduced by the discussion of the gate-control theory. This theory was relevant to this study because it recognizes the promise of modifying pain through a variety of types of psychological interventions.

B. Psychological Approaches to Pain Management

Pain is a psychological experience, yet it did not become an area of interest for psychologists until the past ten to fifteen years. The relatively recent growth of psychological research in this area has been partly due to the impact of the gate-control theory, and partly due to the growing recognition that the psychological status of the patient significantly affects the course of virtually every physical treatment (Weisenberg, 1977).

Mention has been made in the medical literature for years of physician-centered attempts to help patients to decrease the stress of medical treatments, such as providing information about procedures, instructions to relax, and reassurance (for example, Chappell & Stevenson, 1936; Draspa, 1959). There has been a trend in some of the psychological research toward the application of various techniques to increase pain tolerance and reduce suffering in clinical settings which have been much more oriented to providing patients with self-controlled coping skills, in contrast to the more didactic, physician-centered approaches found in the medical literature (Turk, 1978). In fact, references to the potential of applying "learning theories" to problems of pain have only recently appeared in the medical journals (for example, Bond, 1980).

Some examples of recent developments in the application of psychological models and treatments to pain attenuation are: behavioral approaches (Fordyce, 1976, 1978), modelling therapies (Craig, 1978), sensory theory (Chapman, 1978), and cognitive approaches (Meichenbaum & Turk, 1976; Meichenbaum, Turk, & Burstein, 1975; Leventhal & Everhart, 1979).

Of particular interest in this study are the effects of cognitive interventions in reducing the intensity of the experience of pain.

Cognitive Interventions

This section offers an overview of the recent research which has applied various methods of reducing pain and distress through cognitive changes, and some of the related issues are pointed out. Such cognitive manipulations can be considered in two main categories: those which are aimed at enabling the individual to avoid or to block out painful stimulation, and those which require acknowledgement or confrontation of the stimulation. The techniques which encourage the blocking out of stimulation, discussed first, include analgesia instructions, attention-diversion techniques, and attribution techniques.

Analgesia instructions typically take the form of imagining situations that are inconsistent with the painful experience, such as pleasant events or a sensation of numbness (Spanos, Horton, & Chaves, 1975). There is considerable evidence that suggestions of analgesia are effective in increasing the threshold of experimentally-induced pain, whether employed in the context of hypnotic induction or not (Evans & Paul, 1970; Spanos, Barber, & Lang, 1974). Hilgard & Hilgard (1975), however, have produced considerable support for the efficacy of a hypnotic state. Nevertheless, such suggestions, whether the subject is hypnotized or not, appear to reduce "subjective pain", as measured by observed pain behaviors and subjective report, but do not reduce the physiological concomitants such as heart rate and blood pressure.

The usual approach in assessing the effects of cognitive interventions on measures such as pain tolerance has been to compare a number of "strategies" with a no-treatment control group. Three recent studies were chosen as representative of such research. Spanos, Horton, and Chaves (1975), Jaremko (1978), and Beers and Karoly(1979) all compared treatments which consisted of: (a) a reinterpretation of the stimulation from the cold pressor test (subjects were instructed to concentrate on the cooling aspects of the water in the context of an imagined hot desert scenario), and (b) an attempt to direct subjects' attention away from the stimulus (they were instructed to imagine an unrelated situation).

Spanos et al. found that the strategies were effective in raising the pain threshold only for those subjects who had high pre-test pain thresholds, with the relevant strategy being more effective. Such results call into question the utility of such treatments, since they appear to be ineffective with the population having the greatest need for increased pain threshold and tolerance.

Jaremko compared with the two strategies described above a treatment he called a "rationalization strategy", which consisted of instructions to subjects to concentrate on justifying participation in the experiment (for example, receiving extra course credit). He reported that all of the treatments increased pain tolerance, with the reinterpretation treatment being most effective, and rationalization was next most effective. He noted that they were also effective for low-threshold subjects.

Beers and Karoly employed treatments very similar to those in the above studies, adding a "rational thinking" condition, in which subjects were essentially instructed to think positive and cheerful thoughts about the cold pressor experience. They also reported these treatments to be more effective than the control.

The above-mentioned studies were purported to have tested the effectiveness of "cognitive strategies". This was probably a misnomer; these treatments would probably more accurately be called "suggestions". Skills were not taught to subjects, but instead they were given only simple instructions to, for example, imagine a particular scene. In addition, there were some methodological shortcomings. The treatments were extremely brief, which would limit their effectiveness. They were not systematic in the sense of being based on a particular model. Further, there were no checks on whether the subjects actually employed the strategies as instructed, nor whether they understood the instructions or accepted them as useful.

However, the results of these studies did suggest that those treatments which gave task-relevant instructions (for example, to reinterpret the situation as pleasant) were more effective than those which were designed to simply distract subjects or to encourage their denial of the physical sensations (for example, counting backward from 1,000 by threes, as used by Beers and Karoly).

Few generalizations have emerged from the research on the various cognitive distraction techniques (Leventhal & Johnson, 1980). Leventhal and Everhart (1979) have suggested that distraction appears to decrease sudden, acute pain and anticipatory anxiety, but is not effective for inescapable pain. Barber and Cooper (1972) found that attention diversion techniques (counting aloud) were not effective in helping people to withstand pain for more than one minute. Leventhal and Everhart (1979) have noted that the belief that distraction is an effective tool is prevalent among subjects, and it is common for subjects who have employed such techniques to report reduced distress even when their measured pain tolerance is not affected.

Horan (1976) has investigated the systematic application of reality-based imagery to pain reduction, and has called his technique "in vivo" emotive imagery. This is essentially a procedure in which the client is taught to summon images which arouse pleasant feelings, and to employ these in actual uncomfortable situations. Horan (1976) has attributed the success of this technique to a blocking effect on anxiety by the positive feelings resulting from involvement in imagery, similar to the effect in systematic desensitization, and to some direct effect on the sensory pain threshold.

The research discussed so far has generally focussed on one of two approaches to reducing pain and distress: techniques which are designed to enable the individual to avoid noxious stimulation, rather than to acknowledge, monitor, or cope with it. That is, these techniques tend to have in common the direction of the individual's attention away from the stimulation.

The present study focussed on the second category of cognitive interventions: those which encourage the individual to acknowledge painful sensations, and to monitor or cope with them. One of the specific methods of interest is a coping approach based on changing the statements which people make to themselves.

Cognitive Coping Skills

Briefly, a cognitive coping skills approach rests on the idea that the individual's behavior and emotional arousal are mediated by covert verbalizations and images. Meichenbaum (1972a, 1972b, 1973, 1975, 1976, 1977) conceptualized these cognitive events as specific sets of self-instructions which a client could be trained to change. Therapy is a process in which the client comes to recognize the role of self-statements in the maladaptive response chain and to produce intentional and adaptive self-statements. Changing self-statements is integral to a number of cognitive-behavioral therapies (Ellis, 1962, 1970, 1977; Beck, 1976; Mahoney, 1980). However, the specific approach of interest in this study was the cognitive coping approach employed by Meichenbaum (1973, 1977) and Turk (1977, 1978) in the stress inoculation procedure, which is discussed in more detail later in this review. The term "coping" is used because the skills are intended to be applied when confronted with a stress situation, and potentially to a range of problems and situations.

Meichenbaum (1976) has identified three mechanisms by which changing internal dialogue operates. First, self-talk plays a direct regulatory role, similar to that of interpersonal instructions; second, it influences direction of attention; and third, it influences the individual's interpretation of his physical state. Meichenbaum and Turk (1976) have attributed the anxiety-reducing effects of self-statements in pain management to the subject's relabelling and reinterpretation of the physical sensations and arousal. Brucato (1978), however, reported findings which suggested that attentional variables are more influential.

Some recent studies have raised the issue that there are influences other than just the content of subjects' self-talk which determine the effects of cognitive input on pain tolerance and distress. This research has examined the subject's perceived control over the painful situation and the subject's expectations of a treatment's utility.

The findings of a number of earlier studies (Bowers, 1968, 1971; Staub, Tursky, & Schwartz, 1971) showed that subjects' control over the pain situation can modulate pain reactions. Kanfer and Seidner (1973) reported that a self-control strategy was more effective in coping with cold pressor pain when subjects had greater control over the noxious stimulation. These findings were interpreted as an example of the anxiety-reducing effects of lessening of uncertainty, therefore decreasing the intensity of the pain. Two recent studies have focussed on the impact of subjects' feelings of personal competence and control, and of subjects' belief in the efficacy of a treatment in increasing tolerance of noxious stimulation. Avia and Kanfer (1980) reported that cognitive control of pain stimuli was enhanced when subjects received instructions designed to enhance feelings of personal competence and control. (For example, they were encouraged to choose from a number of coping strategies.) A study by Girodo and Wood (1979) yielded results which suggested that the effects of coping self-statements are enhanced by provision of a rationale for the procedure. That is, they proposed that the subject's beliefs and expectations about the utility of a treatment is what determines its success, more so than the semantic meaning of the self-statements.

In addition, the effect of the individual's expectations about the chances of his own success in tolerating pain might influence the effectiveness of a cognitive strategy. Bandura (1977) proposed that behavioral interventions are effective to the degree that they change the individual's expectations of personal effectiveness. "An efficacy expectation is the conviction that one can successfully execute the behavior required to produce the outcomes" (p. 193). These expectations are effective because they "affect both initiation and persistence of coping behavior" (p. 193). The relationship of self-efficacy expectations and pain tolerance has not been investigated.

Stress Inoculation

Because one of the approaches investigated in this study is based very closely on a component of stress inoculation, this treatment method is described here in more detail.

Stress inoculation (Meichenbaum, 1973, 1977) is a comprehensive treatment package which is designed to teach a variety of cognitive skills to enhance ability to cope with stressful situations. Turk (1977, 1978) and Meichenbaum and Turk (1976) have investigated the utility of this approach by applying it to management of experimentally-induced pain. Such an appliation was innovative because the variety of techniques encompassed by this approach were taught to the subjects within the context of the gate-control theory (Melzack, 1973; Melzack & Wall, 1965). Briefly, the techniques were classified according to the psychological dimensions of pain proposed by Melzack: (a) the sensory discriminative (SD) dimension relates to sensory input; therefore these techniques focus on reduction of muscle tension, as in relaxation training; (b) the motivational-affective (MA) dimension has to do with the negative affect which accompanies pain, such as anger and anxiety, and these techniques relate to attention-diversion and imagery manipulations; and (c) the cognitive-evaluative (CE) dimension concerns expectancies, beliefs, and attitudes, and techniques such as self-instructional training (Meichenbaum, 1977) fit into this category.

In practice, stress inoculation for pain involves four phases: (a) an educational phase, in which the client is provided with an explanation of response patterns to pain, in order to give a rationale and understanding of the treatment; (b) a coping skills phase, in which a variety of coping techniques are taught and rehearsed, according to the dimensions of gate-control theory; and (c) an application training phase, in which the client tries out the skills in an actual stressful situation. In the studies using experimentally-induced pain by Meichenbaum and Turk (1976) and Turk (1977, 1978), the latter phase was conducted using imagery-rehearsal and role-playing instead of actual exposure to the pain stimuli. This approach has been reported to be highly effective in increasing pain tolerance and reducing distress from experimentally-induced ischemic and cold pressor pain (Meichenbaum, 1977).

The stress inoculation procedure is lengthy, and some recent studies have investigated the effectiveness of its various components. Horan, Hackett, Buchanan, Stone, and Demchik-Stone (1977) carried out a component analysis of stress inoculation using the cold pressor test. Their results suggested that the educational component alone had no effect, but in combination with the coping-skills component, it was effective in increasing pain threshold and tolerance, and in decreasing self-reported pain. The exposure component was found to have no effect.

Of particular interest in the current study was the self-instructional training provided in the cognitive-evaluative category of the coping skills component. Its rationale rests on the principle of the causal role of cognitions in modulating pain and distress. The goal is to bring cognitive reactions to sensory input under the control of the individual. It essentially involves breaking a stressful situation into smaller, more manageable steps and encouraging the client's self-reflection. Meichenbaum (1977) and Turk (1978) have provided scripts which include models of effective coping statements during each phase.

Hackett and Horan (1980) subsequently undertook a component analysis of the three skills categories of the coping-skills component. They concluded that SD training produced greater pain tolerance, and MA training increased pain threshold. They also reported that the training in the CE category (which consisted of Meichenbaum's self-instructional training) was not effective on any of the measures, and that this approach was largely ignored by the subjects. However, certain methodological features and interpretations of the data were questionable, rendering these conclusions disputable. Raphael (1980) has reported evidence that self-statement instruction was an effective treatment in increasing pain tolerance, and that 95 per cent of the subjects employed this approach as taught, alone or in combination with other strategies.

In summary, a number of cognitive means of changing the experience of pain, involving avoidance of as well as confrontation of physical sensations have been investigated. Obviously there is no lack of such approaches to alter cognitive inputs, and the findings of several studies attest to their effectiveness relative to no treatment. Variables such as pain tolerance seem to be very amenable to change due to cognitive manipulation. Also, factors such as subjects' feelings of personal control and expectations about the utility of a treatment have been reported to affect the outcome of cognitive treatments for pain. Perhaps the effects which have been attributed to the cognitive interventions employed in the research might also be due to other, extra-treatment factors: whether the subjects considered the treatments to be valid, the extent to which they employed the treatments being assessed, what roles their own pain-management strategies played in the outcome, and the subjects' expectations about their own ability to succeed. It is possible that any treatment which alters the individual's thinking about the situation might be effective.

Preparatory Sensation Information

One of the intentions of this study was to compare the effects of two cognitive interventions which require the acknowledgement of the sensations arising from noxious stimulation. One of the approaches, that of cognitive coping skills, has been discussed. The second approach, described here, is that of providing accurate information about the physical sensations which can be anticipated in a stressful situation.

As Turk (1978) pointed out, supplying patients or experimental subjects with accurate and authoritative information is common to both this approach and coping approaches such as stress inoculation. Both of these approaches require acknowledgement and monitoring of the sensations arising from noxious stimulation. However, the preparatory information methods which have been proposed and investigated by Leventhal and his colleagues (Leventhal & Everhart, 1979; Leventhal & Johnson, 1980; Leventhal, Brown, Shacham, & Engquist, 1979; Johnson, 1973; Johnson, Morrissey, & Leventhal, 1973; Johnson, Kirchoff, & Endress, 1975) are based on a different theoretical model than coping skills approaches.

The effectiveness of preparatory information in the reduction of distress during noxious stimulation has been demonstrated in controlled studies employing experimentally-induced pain (Leventhal et al., 1979; Johnson, 1973; Staub & Kellett, 1972). Several field studies have also focussed on this topic, in areas such as the following: preparation for removal of orthopedic casts, (Johnson et al., 1975), endoscopic examinations (Johnson et al., 1973), and recovery from surgery (Sime, 1976).

Leventhal's model is described briefly here, and a discussion of the underlying mechanisms and research background follows. Consistent with gate-control theory, Leventhal conceptualized stress reactions to noxious stimulation as being composed of an informational component, which consists of the sensory attributes (objective features such as intensity, location, and pattern), and an emotional-distress component, which includes emotional reactions to and fearful expectations about the pain experience. His model proposes that the two components are produced and processed simultaneously, and that this occurs preconsciously.

The component of pain that is altered by preparatory sensation information appears to be primarily the emotional-distress response (Johnson, 1973; Leventhal et al., 1979). Leventhal and Johnson (1980) have contrasted this effect with that reported for deep hypnosis (Hilgard, 1973), in which both sensory information and the distress response appear to be blocked from consciousness.

Essentially, an information processing view of pain perception is proposed by Leventhal. According to this model, greater pain will be felt if noxious stimulus information activates memory traces which link distress reactions (anger, anxiety, helplessness) with past noxious experiences. Leventhal and Johnson (1980) noted that the array of sensations experiencd during the cold pressor test are very similar to sensations accompanying most noxious experiences. The mechanism by which sensation information operates, according to Leventhal, is that the recipient monitors the sensations in an objective manner, and the noxious stimulation no longer connects with an emotional memory. Put another way, the sensory informational components of pain can be processed in an objective or an emotional manner. When objectively processed, the noxious input is encoded in terms of specific sensory features, such as coldness or numbness (that is, for their concrete, immediate meaning), and emotional distress reactions habituate. However, when the inputs are emotionally processed, the information is encoded in terms of a pain memory (hence, for their anticipatory, threat value), and distress is stimulated (Leventhal & Everhart, 1979; Leventhal et al., 1979). Hence, the main idea is that distress reduction is not just a matter of changing the individual's expectations or reducing uncertainty; rather, it depends on the way the input is processed.

Two hypotheses have been proposed to explain the effects of sensation information in reduction of distress (Leventhal & Johnson, 1980; Leventhal et al., 1979). The accuracy hypothesis (Johnson, 1973) argues that the information provides the individual with accurate expectations, thereby minimizing uncertainty and enhancing a sense of control. In the processing hypothesis, the critical factor is the objective coding of the noxious stimulation.

Leventhal et al. (1979) carried out a study, part of which was directed at testing these hypotheses. Briefly, there were six conditions: two groups received accurate, detailed, and objective information about the sensations of cold and pain that could be expected during the cold pressor trial, two received information about the cold pressor procedure only, and two received information about sensations arising from arousal. One group in each pair received a warning about pain ("...a sensation of pain, which will begin to get very strong around this time", p. 693). The decline in distress reported by sensation-informed groups was significantly greater than the decline in the other groups. Further, they found that the inclusion of information about the magnitude of pain eliminated the beneficial effects of the sensory information on pain tolerance during cold pressor stimulation, even though the pain warnings were accurate and would be expected to reduce distress, according to the accuracy hypothesis. They suggested that the pain warning activated an emotional pain memory; hence, the sensation cues would be encoded as threats rather than as objective information.

As a further test of these propositions, Ahles, Blanchard, and Leventhal (in press) extended the study discussed above by comparing the distress ratings of three groups of subjects. In one group, the subjects were encouraged to express their emotional reactions to cold pressor pain, in one they were instructed to closely monitor their sensations by describing them aloud during the cold pressor trial, and in one they received instructions intended to distract them from their sensations. The "monitoring" group reported significantly less distress than the other two groups. These findings and those of Leventhal et al. demonstrated that objective processing is based on the focussing of the person's attention on the objective, nonaffective components of the stimulation. Also supportive of the objective processing hypothesis was the finding that the subjects whose emotional processing of the painful stimuli was encouraged reported the most distress. It is important to note that the treatments employed in the study by Ahles et al. were very brief, did not provide subjects with a rationale for using the techniques, and contained no checks on whether the techniques were actually used by the subjects. In view of the questions raised in this review regarding the effect of plausibility of techniques (Girodo & Wood, 1979) and subject-generated strategies (Hackett & Horan, 1980), these shortcomings may have affected the results.

Leventhal (Leventhal et al., 1979) has stated that this focus on preconscious processing should not be viewed as a rejection of other factors in distress reduction, such as coping. However, his definition of coping has been restricted to what he calls "action instructions", directed at overt behaviors, such as properly-timed swallowing during an endoscopic examination (Johnson et al., 1973).

Leventhal (Leventhal & Johnson, 1980) conceptualized sensation information and behavioral instructions as making independent contributions to distress reduction. Sensation information was viewed essentially as reducing fear or inhibiting distress from noxious stimulation. Behavioral instructions were thought to facilitate planning, rehearsal, and enactment of coping behaviors. Leventhal and Everhart (1979) suggested that the decline in distress due to receipt of sensation information reduces interference with coping.

Findings from studies on facilitation of an endoscopic exam (Johnson et al., 1973) and recovery from surgery (Sime, 1976), plus those from a number of unpublished field investigations reported by Leventhal and Everhart (1979) suggested that combinations of sensation information and action instructions are more effective than either treatment alone. Leventhal and Johnson (1980), however, proposed that behavioral instruction is effective only when the situation calls for active participation by the subject. They cited a study by Mills and Krantz (1979) in which blood donors who were given sensory information only were less distressed than were donors who received information plus behavioral instructions. The interpretation was that the donor's opportunity for active coping is limited, and that better adaptation in such a situation is to remain passive.

The coping procedures discussed by Leventhal are based entirely on behavioral practice, and do not include covert cognitive coping strategies such as those proposed by Meichenbaum, which are designed to change the client's cognitive "set" and to teach adaptive modes of thinking about a stressful situation. It is interesting to note that an earlier study (Blitz & Dinnerstein, 1971) resembled a comparison of the effects of instructions to monitor cold pressor sensations and instructions to "change set". One experimental group was told to focus on the cold and ignore the pain, and one was told to reinterpret it as pleasant. Both produced significantly higher pain thresholds than did the control condition, but tolerance was not affected.

Everhart (1978) compared sensation monitoring (attending to physical sensations produced by cold pressor stimulation) and "positive thinking" treatments, and found no differences in distress reduction nor durability of effects. She suggested that these results might mean that positive thinking actually involves sensation monitoring as well as a positive reinterpretation of sensations, hence objective processing plus positive affect are facilitated. However, there has been no research to compare the effects of providing sensation information with the effects of a systematic approach to covert cognitive coping on distress reduction and pain tolerance.

Leventhal and Everhart (1979) have briefly discussed the contributions of conscious activity to pain-distress. They speculated about what they called conceptual processing, which includes the individual's beliefs about the causes and consequences of the pain-distress experience. Leventhal and Everhart suggested that these beliefs might take the form of assumptions (which are not necessarily accurate) about a direct relationship between magnitude of pain and extent of injury, and about the effectiveness of distracting oneself when in pain. That is, they acknowledge that these beliefs serve to guide the individual's behavior to some extent, and may interact with other types of processing, such as formation of schemata.

Leventhal and Everhart have pointed out the need for differentiating between schematic and conceptual mediators. They speculated about whether these are two separate and independent types of cognitive codes, or whether they are on a verbal-controllable/automatic continuum.

C. Conclusions From the Literature

An overview of the literature on the impact of cogitive interventions on pain and distress shows that a number of such methods have been demonstrated to be effective in increasing pain tolerance and reducing distress. However, a number of questions were also raised.

The two approaches which were discussed in detail, cognitive coping and preparatory sensation information, have generated considerable interest and numerous research studies. However, the relative effectiveness of the two approaches has not been investigated. Leventhal and Everhart have suggested that active coping, involving instructions for overt behavioral procedures is not effective in situations where opportunities for active participation are limited. A coping strategy based on covert cognitive intervention has not been compared with the preparatory information approach. Further, the pain stimulus used in this study, that of cold water, is highly appropriate for investigating such an issue because in fact it restricts the subject almost entirely to cognitive strategies, and allows few overt behavioral measures.

The model upon which the preparatory information approach is based attributes the effects of such information to the processing of painful stimulation in an objective manner. This raises the question of what would happen if the converse of objective processing was encouraged. That is, if Leventhal's model is accurate, the subjects whose fearful expectations are raised and who process stimulation in an emotional manner should not be able to withstand pain as long as those who objectively process it, and should report more distress and perhaps greater pain.

Because the pain experience appears to be so readily changed by the use of various cognitive inputs, other cognitive factors which the subject brings to the experiment are assumed to have considerable impact as well. Some recent studies (for example, Kanfer & Seidner,1973, Avia & Kanfer, 1980, Girodo & Wood, 1979) have demonstrated that the effectiveness of various cognitive treatments is enhanced by factors such as whether they are considered plausible by subjects, and subjects' beliefs about their control of the situation. Such evidence suggests that factors extraneous to the actual treatments being studied are at least as responsible for observed changes as are the treatments. Perhaps any treatment, as long as it changes the subject's expectations about the chances of success, would be effective in modulating reactions to pain.

Another major question raised by the literature review relates to the extent to which subjects actually employ the treatments as instructed.

D. Formulation of the Study

This section provides a brief description of how this study was carried out. Also included are outlines of the method of pain induction and of the four treatments.

The experimental conditions were: Instruction in cognitive coping skills, provision of preparatory sensation information, and a treatment designed to enhance emotional processing. Each group received one of the above treatments before being exposed to painful stimulation, that of cold water. The subjects in the control group were exposed to the cold water twice: once with no treatment and once after hearing a neutral treatment.

The cold pressor test is a widely-used method of stimulating pain in experimental settings, and in fact, was the pain stimulus employed in the majority of the studies surveyed in the literature review. Essentially it requires the subject to place his hand in ice-cold water, and allows a measure of pain tolerance, that is, the maximum length of time the subject is able to withstand the pain. According to Gelfand (1964), pain tolerance has a larger psychological component than does pain threshold, the point at which pain is first felt.

Hilgard and Hilgard (1975) noted that the colder the water, the greater the pain reported by subjects. They have concluded that time in cold water can be used as a measure of pain tolerance as though intensity of stimulation was increasing at a uniform rate, although in fact the deeper tissues of the hand are cooled less rapidly than those on the surface, because of the nature of the changes in bloodflow.

Cold pressor stimulation was chosen as the laboratory pain analogue for a number of reasons. To paraphrase Leventhal et al., this technique is ideal for the investigation of the mental processes accompanying pain because it provides a variety of sensations, with a sufficiently slow onset of distress to allow time for psychological techniques to be effective. In addition, the task involved is not especially threatening, and is convenient to use. Brown, Fader, and Barber (1973) and Clark and Hunt (1971) supported the use of cold pressor stimulation as one of the best laboratory analogues to clinical pain. Wolff (1978) also attested to this method as one of the most valid methods of measuring pain.

The four treatments employed in this study are described in more detail. The complete scripts of the treatments are presented in Appendices II to V.

1. The cognitive coping skills treatment. This treatment was closely based on Meichenbaum's (1977) stress inoculation script. A rationale for the treatment, the connection between self-statements and experience of pain, and breaking a stressful situation into smaller steps, were discussed. Examples of effective coping self-statements were included, as well as instructions and time for mental rehearsal of the statements.
2. The sensation information treatment. The rationale for this treatment was the reduction of distress by encouraging the objective processing of sensory input. This was accompanied by the individual's focussing on the sensory informational components of the input. The treatment used in this study conformed very closely to the script provided by Leventhal et al. (1979). It provided the subject with accurate, detailed, and

objective information about the sensations of cold and pain that could be expected during the cold pressor trial. Information about signs of emotional arousal (for example, "a feeling of butterflies in the stomach") were also included. In addition to Leventhal's script, this treatment also contained a list of objective descriptors which were derived from the list provided by Melzack and Torgerson (1971).

3. The emotional processing treatment. The objective of this treatment was to promote emotional processing, according to Leventhal's hypothesis. The subjects receiving this treatment were instructed to express any emotion associated with the sensations from the cold pressor (for example, by moaning, swearing, or talking). The script also included a simple rationale for using this approach, and a list of "emotive" words which were derived from Melzack and Torgerson's (1971) work. This treatment also provided rehearsal time.
4. Placebo. The control subjects listened to a reading from Kavaler (1970) about physiological changes in reaction to cold, which was neutral in tone, and offered no instructions or advice.

E. Research Questions

The main questions addressed in this study were:

1. In an analogue pain situation, what are the effects on pain tolerance, reported distress, and reported

discomfort of three approaches to modifying pain:

a. a cognitive coping skills approach

b. preparatory sensation information, intended to facilitate objective processing

c. an approach intended to facilitate emotional processing.

2. How do the three approaches and a placebo treatment compare in effectiveness?

3. To what extent is subjects' perceived potential effectiveness of a given treatment related to their pain tolerance, reported distress, and reported discomfort?

4. To what extent is subjects' rating of their confidence in their own ability to withstand the stimulation from the cold water related to their pain tolerance, reported distress, and reported discomfort?

5. To what extent is subjects' perceived potential effectiveness of a treatment related to whether they actually employ it?

6. To what extent is reported frequency of thoughts of injury related to the treatment used?

7. Do the subjects actually employ the treatments as presented?

III. METHOD

The main purpose of this study was to compare three cognitive modification treatments, a placebo treatment, and a control on an analogue test of pain. In addition, a number of other questions, as outlined in Chapter II, were answered. The method employed to carry out this study is described in this chapter.

A. Design

A total of 80 subjects were randomly assigned to one of four groups: (a) a control group (C), (b) a sensation information group (SI), (c) a cognitive coping skills group (CC), or (d) an emotional processing group (EP). All groups, with the exception of the control group, received a treatment followed by the analogue test of pain. The control group received the pain test twice: first, without any treatment, in order to assess the effects of the treatments compared with no treatment, and second, following a placebo treatment.

The design of the experiment has been classified by Campbell and Stanley (1963) as being a post test only control group design, and was rated by them as being an example of true experimental design. The design is illustrated in Figure 1.

Figure 1

Design of Experiment

R (80 subjects)	O X O	Control followed by placebo.
	X O	Sensation Information.
	X O	Cognitive Coping.
	X O	Emotional Processing.

R - randomization, X - treatment, O - observation

B. Subjects

A total of 86 subjects participated in the experiment. Equipment malfunction early in the experiment caused six subjects to be omitted from analysis. The remaining 80 volunteer subjects were randomly assigned to the conditions, with the restriction that one subject was run in each of the four conditions before beginning another set of four. The subject sample was made up of volunteers who were asked by the experimenter to participate in a study dealing with "psychological and physical reactions to cold temperatures". Potential subjects were told that they would be asked to immerse their hands in cold water. References to pain were omitted in descriptions of the experiment, to avoid possible bias. In addition, it was ensured that none of the subjects had had prior experience with the cold pressor test.

Subjects were recruited from undergraduate Education classes at the University of Alberta and from several Psychology classes at a local community college. Subjects ranged in age from 18 to 52 years, with a mean age of 24.93

years, and a standard deviation of 6.96 years. There was an equal distribution of sexes in each group.

C. Apparatus and Experimental Setting

For the convenience of the subjects, it was necessary for testing to be completed in three locations. An effort was made to ensure that the experimental conditions were similar for every subject.

Each subject was seated in a comfortable chair, facing the tape recorders, with the container of ice water to his or her right. The apparatus was positioned so that, during the cold pressor trial, subjects were able to allow their arms to hang loosely without support or effort. Subjects were informed that the experimenter would stay out of sight during the treatment and cold pressor trial, in order to minimize distraction.

The pain stimulus employed in this study was the cold pressor test. The container of water into which subjects' hands were placed remained in a larger insulated container which was packed with ice, and the water temperature was maintained at 1 degree C. by the addition of small pieces of ice. The water temperature was checked before and after each trial. The subjects were not told the temperature of the water. A stopwatch was used to determine the number of seconds that each subject's hand remained in the water.

D. Procedure

The collection of data was carried out by two experimenters. Each instructional tape was identified by a code number to minimize experimenter bias, since the experimenter was unaware of which treatment was adminstered to a particular subject.

Before assignment to a condition, enquiries were made of all subjects as to whether they had a history of frostbite, to ensure safety, or prior experience with the cold pressor test, to reduce bias. None of the subjects were disqualified for either of these reasons.

Following screening, recording of age and sex, and assignment of condition, the subject was seated with the apparatus positioned as already described. The procedure for the subjects assigned to experimental groups follows.

All subjects were read the same introduction by the experimenter, the script of which is presented in Appendix I. It indicated that the study was about "psychological and physical reactions to cold temperatures" and included statements about the procedure of the cold pressor test and its safety, and about the treatment's effectiveness. Before the subjects put on the headphones, they were asked if they had any questions about the procedure. After hearing the audiotaped treatment, the subject completed the first set of ratings. (The items are contained in Appendix VI.) Then the subject completed the cold pressor trial and subsequently the second of ratings. The experimenter then carried out the structured interview, which was audiotaped. To ensure reasonable uniformity of interview conditions, the interview script was followed closely and prompts were clearly specified and adhered to (Appendix VII).

A description of the procedure for subjects in the control group follows. The control subjects were assured of the safety of the cold pressor test and were asked to keep their hands in the cold water as long as possible. Following the trial, they were provided with warm water and a period of time for hand warming. They also completed the questionnaire items which were directly relevant to the cold pressor test (see Appendix VI). Then they listened to the "placebo" audiotape, and responded to the items related to how useful they thought the information would be and how confident they were in their own ability to to keep their hands in the water. Following that, they completed the second cold pressor trial, and completed the remaining items. Like the experimental subjects, control subjects were also interviewed.

E. Treatments

The scripts of the audiotaped treatments are presented in Appendices II to V. The coping skills treatment was described in Chapter II, and was very closely based on the cognitive-evaluative component of Meichenbaum's (1977) stress inoculation procedures. The sensation information treatment was very similar to that used by Leventhal et al.

(1979), with some additions based on the list of descriptive terms for pain provided by Melzack and Torgerson (1971). The emotional processing treatment was designed to encourage emotional processing and included emotive terms derived from Melzack and Torgerson. The placebo treatment consisted of a reading about physiological reactions to cold (Kaveler, 1970, pp. 26-30).

F. Variables

In order to assess the effects of the treatments, all of the subjects were administered the cold pressor test and were asked a number of questions, along the following dimensions. All of the scales were scored on a seven-point Likert-style scale.

1. Confidence in own ability (Confidence): Subjects' response to the following question: "Indicate how confident you are in your own ability to keep your hand in the cold water". (1 - not confident, 7 - very confident)
2. Perceived effectiveness of treatment (Effectiveness): Subjects' response to the following question: "Indicate how useful you think the information you heard on the tape will be in helping you to keep your hand in the cold water". (1 - not useful, 7 - very useful)
3. Sensitivity to pain (Sensitivity): Subjects' response to the question : "Generally speaking, how sensitive are you to pain?" (1 - very little, 7 - very sensitive)

4. Pain tolerance: The number of seconds subjects held their hands immersed in the ice water.
5. Distress: Subjects' response to "Indicate the amount of upset and emotional distress you experienced while your hand was in the cold water". (1 - very low, 7 - very high)
6. Discomfort: Subjects' response to the question: "Indicate the intensity of the physical discomfort you experienced while your hand was in the cold water". (1 - very low, 7 - very high)
7. Helpfulness: Subjects' response to the following statement: "The audiotape was helpful to me in keeping my hand in the cold water". (1 - strongly disagree, 7 - strongly agree)
8. Use of treatment: Subjects' response to the following question: "Did you use what you learned from the taped talk while your hand was in the cold water?" (1 - not at all, 7 - all of the time)
9. Danger of injury: Subjects' response to the following question: "While your hand was in the cold water, how often did you think that your hand might be in danger of injury?" (1 - not at all, 7 - all of the time)

G. Analysis

In Chapter II the purposes of the study were specified. The particular questions addressed in this study are reiterated, followed by the method of analysis employed in answering the questions.

1. What are the effects on pain tolerance, reported distress, and reported discomfort of three approaches to modifying pain?

   Analysis Number 1. A one-way analysis of variance was used, comparing the mean scores of each of three treatment groups to the mean score of the control group on the measures of tolerance, discomfort, and distress.

2. How do the three approaches and a placebo treatment compare in effectiveness?

   Analysis Number 2. A Scheffe test comparing the means of each of the above groups on the variables of tolerance, discomfort, and distress was carried out.

3. To what extent is the subjects' perceived potential effectiveness of a given treatment related to their pain tolerance, reported discomfort, and reported distress?

   Analysis Number 3. Pearson product moment correlations were reported on the relationship between subjects' confidence in a given treatment and their tolerance, discomfort, and distress.

4. To what extent is the subjects' ratings of their confidence in their own ability to withstand stimulation from the cold water related to their measured pain tolerance, discomfort, and distress?

   Analysis Number 4. Pearson product moment correlations between the variables were derived.

5. Do the subjects employ the treatments as presented?

Analysis Number 5. The distribution of responses to the question on use of treatment will be reported. The results of the interviews were also summarized.

6. To what extent is the subjects' perceived potential effectiveness of a treatment related to whether they actually employ it?

   A Pearson product moment correlation was derived for the use of treatment to the subjects' ratings of confidence in treatment.

7. To what extent is reported frequency of thoughts of injury related to the treatment used?

   Analysis Number 7. A Scheffe test was used to compare the means of each group on the variable of thoughts of injury.

In the analysis of the data a probability level of $p<.05$ was deemed necessary to support the hypotheses that the differences that exist occur at a greater degree than what might be expected by chance.

IV. RESULTS

In this chapter the results of the analyses suggested in the previous chapter are presented, as well as a discussion of further analyses of the data collected.

A. Analysis of Variance

Table 1 summarizes the analyses of variance of the differences among the four groups on the measures of pain tolerance, distress, and discomfort. It is followed by the means and standard deviations (Table 2) of the four experimental groups and the summary of the Scheffe tests (Table 3), in which the probabilities of differences between each of the groups is given.

Results of the analyses of variance indicate a significant difference among the four groups on the dimension of pain tolerance ($p = 0.006$). However, there were no differences in the amount of reported discomfort or distress. An analysis of the group means on pain tolerance indicated that the subjects in the three treatment groups were able to keep their hands immersed in the ice water for approximately twice as long as those in the control group. Little difference was apparent among the three experimental groups.

Another feature of note in this analysis is the large variability within groups on the measure of pain tolerance. The standard deviation for each of the groups was over 90 seconds.

Table 1

Analysis of Variance of Mean Scores of Pain Tolerance, Distress, and Post Treatment and Control Measures

	Source of Variation	df	MS	F ratio	P
Pain Tolerance *	Between Groups	3	55384.73	4.54	0.006
	Error	76	12194.34		
Distress *	Between Groups	3	1.35	0.49	0.692
	Error	76	2.77		
Discomfort *	Between Groups	3	3.08	1.65	0.186
	Error	76	1.87		
Pain Tolerance **	Between Groups	3	5674.63	0.44	0.727
	Error	76	12975.18		

* Comparison of post treatment and post control measures
** Comparison of post treatment and post placebo measures.

Table 2

Mean Scores and Standard Deviations of Measures of Pain Tolerance, Distress, and Discomfort on Experimental Groups

Group	Pain Tol.		Distress		Discomfort	
	Mean	SD	Mean	SD	Mean	SD
Control	105.20	101.23	3.00	1.58	4.40	1.56
Sensat'n Inform.	201.85	112.14	3.60	1.53	5.35	1.11
Cog. Cop.	223.45	103.76	3.45	1.63	4.75	1.04
Emot'l Proc.	199.75	112.75	3.45	1.75	4.80	1.54
Post Placebo	182.35	115.28				

Table 3

Scheffe Contrasts on Group Means for Pain Tolerance

Group	Pain Tolerance 1	2	3	4
Control*	-	0.03	0.007	0.035
Sensation Inform.		-	0.950	1.00
Cognitive Coping			-	0.93
Emotive Processing				

* one-tailed test of significance

On the measures of distress and discomfort there was no significant difference between any of the four groups. There were also no significant differences between the treatment group means and that of the no-treatment control group.

It should be noted that in all six comparisons between treatment and control groups, the treatment subjects reported feeling more distress and discomfort than did those in the control group.

B. Correlations

In order to test the relationship between the variables described in the previous chapter, Pearson product moment correlations were calculated between the variables designated by the research questions. In Table 4 the correlations for the combined groups are reported, and Table 5 shows the levels of significance of those correlations.

Results of the correlations indicated that 18 of the 36 possible correlations proved to be significant ($p<.05$).

The results indicated that subjects' perceived effectiveness of a given treatment was related to the length of time they were able to keep their hands in cold water ($r = .27$, $p = .01$). Amount of distress experienced during the cold pressor test was inversely related to subjects' perceived effectiveness of a treatment ($r = -.31$, $p = .005$), as was intensity of discomfort ($r = -.25$, $p = .02$).

Table 4

Pearson Product Moment Correlations
Among Nine Variables For Four Groups
N = 80

Variable	1	2	3	4	5	6	7	8	9
1. Confidence		.14	-.008	.12	.10	.03	.56	.48	-.06
2. Effectiveness			-.270	.27	.31	-.25	-.01	-.12	-.37
3. Sensitivity				-.33	.21	.35	.05	.06	.24
4. Pain Tolerance					-.28	-.30	.10	.03	-.22
5. Distress						.52	.13	.26	.23
6. Discomfort							.05	.23	.12
7. Helpfulness								.78	-.02
8. Use of Treatment									.05
9. Danger of Injury									

Table 5

Levels of Probability of Pearson Product Moment Correlations Among Nine Variables For Four Groups

Variable	1	2	3	4	5	6	7	8	9
1. Confidence		.21	.94	.250	.340	.740	.00	.00	.580
2. Effectiveness			.01	.010	.005	.020	.89	.27	.001
3. Sensitivity				.003	.050	.001	.61	.56	.030
4. Pain Tolerance					.009	.006	.34	.75	.040
5. Distress						.000	.24	.01	.030
6. Discomfort							.63	.03	.270
7. Helpfulness								.00	.820
8. Use of Treatment									.610
9. Danger of Injury									

There were no significant correlations between the amount of confidence subjects reported in their own ability to keep their hands in the cold water and their measured pain tolerance (r = .12, p = .25), distress (r = .10, p = .34), and discomfort (r = .03, p = .74).

C. Use of Treatments

Table 6 summarizes the analysis of variance of mean scores for the four groups on use of treatment. Following that, the means and standard deviations of each group are given in Table 7. Table 8 shows the results of the Scheffe test for contrasts of group means.

Results of the analysis indicated that none of the groups reported a high degree of use of the treatment in keeping their hands in the water. All of the groups with the exception of the emotional processing group reported the treatments as more useful than the control. Both the sensory information and the cognitive coping treatment were rated significantly more useful than the emotive processing treatment.

The correlation between subjects' rating of helpfulness of the treatments and their pain tolerance was low (r = .03).

In relating the subjects' expectations about effectiveness of treatment to whether they actually employed it (Table 4), the correlation was also low (r = -.12).

Table 6

Analysis of Variance of Mean Scores of Four Experimental Groups on Use of Treatment

Source of Variation	df	MS	F ratio	P
Between Groups	3	20.02	8.18	0.000
Error	76	2.45		

Table 7

Means and Standard Deviations of Four Experimental Groups on Use of Treatment

	Post Placebo	Sensation Information	Cognitive Coping	Emotional Processing
Means	3.05	4.60	5.05	3.20
Standard Deviations	1.28	1.66	1.32	1.78

Table 8

Scheffe Contrasts on Group Means
For Use of Treatment

	1	2	3	4
1. Post Placebo		.02	.002	.990
2. Sensation Information			.840	.050
3. Cognitive Coping				.005
4. Emotional Processing				

D. Placebo

The first administration of the cold pressor test to control subjects was preceded by instructions to the subjects to immerse their hands in the water as long as they were able to, and a statement regarding the safety of the procedure. A second cold pressor trial was administered to control subjects following the placebo treatment. The results indicated that these subjects had greater pain tolerance following the placebo than with no treatment. This analysis did not allow the partialling out of the effects due to practice and due to the placebo. Comparing the differences between the post-placebo pain tolerance results and the treatment group results, no significant differences were found.

E. Other Analyses

Multivariate Analysis of Data

Employment of univariate statistics in analyzing data can give rise to two possible problems: (a) tests can be found to be significant due to chance because so many one-way tests are repeated, and (b) certain data which are significant can be discarded because one is not able to analyze data on the combined effect of different variables.

In using multivariate analysis of variance (MANOVA), the following variables were combined: (a) pain tolerance, distress, and discomfort, (b) use of treatment and helpfulness, and (c) confidence and effectiveness.

Results of the MANOVA indicated overall significant differences on each of the three analyses (F = 2.98, 2.37, 9.24; p = .002, .032, .000 respectively). In contrasting each of the experimental groups with each other in the MANOVA, the results indicated that each of the treatment groups was significantly different from the control group on the three variable groups, with one exception. That exception was that there were no differences between the control group and the emotional processing group on the combined variables of confidence and effectiveness.

In contrasting the treatment groups, differences were found between the cognitive coping and the sensation information groups on their confidence in treatment plus rating of effectiveness of the treatment. Both the cognitive coping and sensory information groups were found to be significantly higher than the emotional processing group on the combined helpfulness and use of treatment variables.

Apparently the only information gained from the MANOVA that was not predictable from the one-way ANOVA were the three differences on the combined variables of confidence and effectiveness. This indicated that the control group was rated lower than either the cognitive coping or the sensation information treatments, with the cognitive coping treatment being rated more highly than the sensation information treatment.

A summary of the ANOVA, MANOVA, and MANCOVA results is presented in Table 9.

When multivariate analysis of covariance was carried out, the dependent measures of pain, distress, and discomfort were combined, as were the measures of use of treatment and helpfulness of treatment. In these analyses, subjects' confidence in their ability to hold their hands in the water, their perceived effectiveness of the treatment, and the rating of their sensitivity to pain were used as covariates, independently and combined.

Table 9

Summary of Results of Analysis of Variance, Multivariate Analysis of Variance and Multivariate Analysis of Covariance

	ANOVA		MANOVA		MANCOVA	
	Overall F	Signif. Contrasts	Overall F	Signif. Contrasts	Overall F	Signif. Contrasts
Confidence	2.69 p=.05	None	2.37 p=.032	1<2 1<3	N/A	
Effectiveness	2.24 p=.09	None		2<3		
Pain Tolerance	4.54 p=.006	1<2 1<3 1<4			F=7.35 p=.000	1<2 1<3 1<4
Distress	.49 p=.69	None None	2.98 p=.002	1<2 1<3 1<4		
Discomfort	1.65 p=.186	None None				
Helpfulness	F=6.72 p=.000	2>4 3>4 1<3	F=9.24 p=.000	1<2 1<3 2>4 3>4	F=7.32 p=.001	1<2 1<3 1<4 3>4 2>4
Use of Treatment	F=8.18 p=.000	1<2 1<3 2>4 3>4				

MANCOVA results were consistent with those from MANOVA, showing differences between all treatment groups and the control group, and no differences among the treatment groups, with the exception of the sensory information and the cognitive coping treatments being better on the combined dependent variables of use of treatment and helpfulness for the emotional processing group. The emotional processing group was lower than the two other treatment groups on both of these variables.

Nonparametric Analyses

The relative power effects of the treatments were analyzed by examining their rankings on the different variables. (The variables of age and sensitivity to pain were omitted.) The rankings on the variables are shown in Table 10.

A comparison of the four groups is included to show the percentages of subjects reaching various levels of pain tolerance on the cold pressor test (Table 11).

Table 10

Relative Rankings of the Three Treatment Groups

	Number of Times Rated		
	Highest	Middle	Lowest
1.Sensation Information		5.0	1
2. Cognitive Coping	6.5	0.5*	
3. Emotional Processing	0.5	0.5	6

* On the variable of distress, Groups 2 and 3 were rated equally.

Table 11

Percentages of Subjects at Designated Levels of Tolerance on the Cold Pressor Test

	Time in Water (Seconds)						
	0 to 50	51 to 100	101 to 150	151 to 200	201 to 250	251 to 299	Max.
Sensation Information	20	10	10			15	45
Cognitive Coping	10	10	5	10		10	55
Emotional Processing	10	25	5	5		5	50
Control Group	50	15	15			5	15
Post Placebo	10	35	5			10	40

This was done because in using analysis of variance in comparing the effects of treatments between groups, the variation within a particular treatment, if large, as was the case in the current study, will tend to mask the differences between groups. Reporting data as variations around the mean can, at times, be misleading if, in fact, few subjects perform at the mean.

Table 11 shows that the experimental groups tended to not differ much in their distribution of pain tolerance times. Approximately half of the treatment subjects were able to reach the limit of 300 seconds on the cold pressor test, while only three of the twenty control subjects could do so. Also, one-half of the control subjects were unable to go beyond the 50-second point.

Analysis of Variance: Additional Findings

Information other than that required to answer the main research questions was collected. In addition to the length of time the subjects held their hands in the cold water and their reported distress and discomfort, information on the following variables was collected: age, subjects' confidence in own ability, perceived effectiveness of treatments, usual sensitivity to pain, helpfulness of treatments, extent to which treatments were used, and thoughts about possible injury. (The questionnaire is presented in Appendix VI).

Table 12 shows a summary of the means, standard deviations, levels of significance, and significant contrasts for all collected variables.

Table 12

Summary of Means, Standard Deviations, p, and Significant Group Contrasts (Scheffe Test) on the Four Groups

Variable	1 Control	2 Sens'n Inform	3 Cog. Cop.	4 Emot'l Proc.	P	Signif. Contrasts	Placebo
Age	25.35 (8.40)	23.55 (7.48)	23.85 (4.72)	28.95 (6.14)	.40	NIL	
Confi-dence		4.75 (1.26)	5.10 (1.41)	4.25 (1.30)	.05	NIL	4.05 (1.07)
Effect-iveness		4.25 (1.22)	5.30 (1.05)	4.80 (1.12)	.09	NIL	4.75 (1.55)
Pain Toler-ance	105.20 (101.23)	201.85 (112.14)	223.25 103.76)	199.75 (112.91)	.00	1<2, 1<3 1<4	182.35 (115.28)
Dis-tress	3.00 (1.58)	3.60 (1.53)	3.45 (1.63)	3.45 (1.75)	.69	NIL	
Dis-comfort	4.40 (1.56)	5.35 (1.11)	4.75 (1.04)	4.80 (1.54)	.18	NIL	
Helpful-ness		4.70 (1.76)	5.45 (1.24)	3.25 (1.76)	.00	1<3, 2>4 3>4	3.95 (1.56)
Use of Treatment		4.60 (1.66)	5.05 (1.32)	3.20 (1.78)	.00	1<2, 1<3 2>4, 3>4	3.05 (1.28)
Danger of Injury		2.50 (1.57)	2.35 (1.49)	2.60 (1.83)	.93	NIL	2.30 (1.58)

In addition to the other differences between the control and treatment groups on pain tolerance which were previously cited, significant differences were also found between groups on the measures of helpfulness and use of treatments. The emotional processing group was not significantly different than the control group on these two measures and was significantly less than both of the other treatment groups. Both the cognitive coping and sensation information groups reported using the treatment more than did the placebo group, while only the cognitive coping treatment was seen as being more helpful than the placebo.

Because the characteristics of the experimental situation appeared to have some influence on the subjects' behavior, the question of whether subjects' pain tolerance times might have differed according to which of the two experimenters they had contact with. However, analysis of variance revealed no differences between the two groups.

F. Results of the Interview

The results of the interview (see Appendix VII) were not appropriate for statistical analysis. The responses to the interview questions regarding thoughts during the cold pressor trial and strategies employed at that time were combined and categorized. Some basic observations are shown in Table 13.

Table 13

Techniques Reported by Subjects in Interview

	Treatment Group				
	Placebo	Sens'n Inform.	Cog. Cop.	Emot'l Proc.	Tot.
Use of Treatment					
-Exclusively	1	7	2	4	14
-Partially	1	3	7	0	11
Distrac'n Techniques					
-Counting	5	2	0	3	10
-Warm Imagery	2	2	3	1	8
Vaguely Described Techniques	6	4	6	8	24
Other Techniques					
-Relaxat'n	0	1	3	0	4
-Self reassur'ce	4	3	1	0	8
-Daydream.	1	0	2	1	4
-Comparison With Previous Exper'ces	0	0	1	2	6

Perhaps most notable is the finding that only about one-third of the subjects reported in the interview that they used the treatment alone or in combination with other techniques. Also, the reports of techniques of almost as many subjects were too vague to be classified. For example, they responded to the queries regarding their thoughts and their strategies during the cold pressor by saying only that they "didn't worry", or "did my best".

In response to the question "what made you want to hold your hand in the cold water?", about one-third reported "curiosity" as their motive. Other relatively frequent responses were that they had set a time goal and they had wanted to attain it, and that they had viewed the task as a personal challenge. Numerous subjects also had difficulty reporting on their motives.

V. DISCUSSION, CONCLUSIONS, AND IMPLICATIONS

The purposes of this chapter are to discuss the results reported in the previous chapter, to summarize the conclusions drawn from this research, and to propose further areas of research.

A. Discussion of Results

All three treatment groups obtained higher pain tolerance levels than did the no-treatment control group. This is a notable finding, because according to Leventhal's hypothesis, the group which was encouraged to process the sensations from the cold water in an emotional manner would be expected to have lower pain tolerance than would those who processed the sensations objectively, and perhaps even less than the those who relied entirely on self-generated strategies (no-treatment control subjects). In fact, the subjects in the emotional processing group were able to tolerate the noxious stimulation as long as were the other treatment subjects.

The results also indicated that the group receiving the placebo treatment obtained significantly higher pain tolerance scores than those obtained under no-treatment conditions. Further, the pain tolerance scores of the post-placebo group did not differ from those obtained by the treatment groups.

Because the use of a placebo in an analogue study is not typical, further discussion of this topic is warranted.

Direct evidence of the effects of repeated exposures to the cold pressor test on pain tolerance scores was not available in the literature. However, Hackett et al. (1979), in contrasting stress inoculation with single and multiple exposures, found that repeated exposures improved pain tolerance no more than a single exposure. Based on this evidence, the pain tolerance scores obtained on the second administration of the cold pressor test, following the placebo, were assumed to have not been influenced particularly by the first exposure.

It should be noted that although placebo treatments are often employed in clinical studies, they are usually not included in analogue studies. The purpose of an analogue study is to compare, in an experimental context, relevant aspects of different treatments, and is less concerned with assessing their "real" effectiveness. The reader is reminded that neither the treatments employed in the current study nor the cold pressor test are examples of realistic clinical treatment. A placebo was included in the design of this study to aid examination of factors extraneous to treatments, specifically those influencing motivation. In view of the findings that similar results on the pain tolerance measure were obtained from all subjects after receiving a treatment, regardless of group membership, it would appear that the effects of the treatments were not all that powerful. The significant differences obtained between treatment groups and the control group were probably due to some extent to situational factors affecting the subjects' motivation.

Further on the topic of pain tolerance, there was considerable variability within the groups on this measure; the standard deviation was over 90 seconds, while the limit was only five minutes. This shows that subjects within any single treatment group displayed considerable differences in their capacity to tolerate pain. However, the four groups did not differ much in the distribution of their pain tolerance scores (Table 11). The proportion of control subjects who reached the 300-second limit was consistent with the usual findings reported in the literature for subjects relying on their own strategies. However, the number of treatment subjects who tolerated the stimulation from the cold water for the full five minutes was unexpectedly high. In addition to the effects of the treatments, there are two factors related to experimental conditions which might have contributed to these results. First, none of the subjects employed in this study were informed of its actual purposes. All of them were told only that it was about reactions to cold, whereas in other studies, such precautions were not necessarily taken (for example, Beers & Karoly, 1979; Raphael, 1981). In these cases, the subjects' expectancies about being exposed to pain, which would be a more threatening prospect than exposure to cold, may have influenced their capacity to withstand the stimulation. Second, all subjects in the current study were volunteers, while in other studies employing the cold pressor test, incentives for participation, such as course credit, were typically offered (for example, Leventhal et al., 1979; Hackett et al., 1979; Hackett & Horan, 1980). In view of the findings of Zimbardo, Cohen, Weisenberg, Dworkin, and Firestone (1966) in their study of the impact of rewards on the experience of pain, subjects who are offered incentives for participation in studies of this nature would be expected to experience greater pain, and hence obtain lower pain tolerance scores.

In addition, the distribution of pain tolerance times suggests that there appears to be an adaptation period in the cold pressor test up to about 100 seconds during which subjects are most likely to terminate, if they are to do so at any point before the maximum time. Also it should be noted that as many subjects in the emotional processing group reached the maximum as in the other treatment groups.

In summary, situational factors related to motivation are important in the experience of experimentally-induced pain, and probably clinical pain, and must be taken into consideration when comparing the results of various studies.

No differences were found between any of the groups on subjects' ratings of intensity of discomfort and amount of distress experienced during the cold pressor trial. Interestingly, the treatment group subjects, on all six comparisons between treatment and control groups, reported more distress and discomfort than did the subjects in the control group. These results might suggest that the treatments enhanced subjects' ability to tolerate pain, but did not actually reduce the intensity of the discomfort or distress. The greater pain (distress and discomfort) reported by treatment subjects than by control subjects may have been related to the fact that they held their hands in the water for a longer period, hence, had more opportunity to experience painful sensations and distress.

These findings are in contrast to those of Leventhal et al. (1979). In that study, distress ratings were obtained in essentially the same manner as in this study, but were repeated a number of times. The authors stated that sensation-informed subjects reported significantly less distress than did those receiving other kinds of information. Hence, no support was found in these results for Leventhal's contention that sensation information reduces distress during contact with a noxious stressor. Further, the pain warning included in the emotional processing treatment in the current study did not have the effect of increasing distress, as was reported by Leventhal et al. It should also be noted that the distress ratings obtained in the current study were quite low, which may have been due either to significant anxiety-reducing effects of the act of receiving a treatment or placebo, or because there was little actual threat inherent in the experimental situation.

The extent to which subjects perceived the treatment they had just heard on the audiotape as being useful was related to their experience of pain. The more useful they thought the information would be, the more successful they were in keeping their hands in the cold water. Significantly less distress and discomfort were also reported by those who said they expected to be helped by the treatment. The subjects apparently saw all of the treatments, including the placebo, as having equal potential usefulness before the cold pressor trial. However, the sensation information and cognitive coping treatments were reported to have been more helpful after the trial than were the placebo and emotional processing treatments. The subjects' ratings of a treatment's potential usefulness prior to the cold pressor test were not related to the extent to which they said they actually used it to withstand the stimulation.

The item relating to subjects' confidence in their own ability was included to check whether, in fact, expectations of self-efficacy were associated with greater pain tolerance. The results suggested that the subjects' expectations about their own success in tolerating pain was not related to their measured pain tolerance, nor to their reported distress and discomfort.

It is also noteworthy that there was little relationship between subjects' rating of how helpful they thought the treatments were and their measured pain tolerance. Apparently a treatment procedure can effectively change capacity to withstand pain regardless of the subjects' perceptions of it as being helpful.

The treatment and placebo groups did not differ as to the extent to which subjects said they thought about the possibility of injury from exposure to the cold water. These results indicate that the cognitive coping treatment, which is specifically designed to alter fear-related thoughts, was not more effective in accomplishing this aim than were the other treatments. Further, the emotional processing treatment, which was designed to increase fearful expectancies, did not increase thoughts about injury. It should be noted that all subjects were assured at least once that no injury would be incurred from the exposure to cold water. Judging from the low mean scores obtained on the scale pertaining to thoughts about injury, that precaution alone may have lowered subjects' anxiety and decreased related thoughts.

Subjects receiving the sensation information and coping skills treatments reported these to be more helpful and to have used them more than those who received the emotional processing or placebo treatments. It should be borne in mind that only the cognitive coping and the emotional processing treatments contained actual suggestions to be used in the painful situation. Hence, the subjects would not "use" the sensation information treatment in the same way.

Apparently the emotional processing treatment lacked credibility, which is not surprising since it was based solely on the converse of Leventhal's objective processing, and not on a tested systematic treatment approach. Although this treatment was as effective in increasing pain tolerance as the other treatments, it was generally less satisfactory than the other two treatments, from the point of view of the subjects.

B. Use of Treatment

The objective of the interview was to investigate in more detail the techniques which were employed by the subjects in attempting to tolerate noxious stimulation. The results, which are discussed below, raised two main issues. The first issue concerns the apparent low usage by subjects of the treatments under scrutiny. The second has to do with the suitability of subjects' self-report as a source of information about mental processes. Both have direct bearing on the methodology of studies investigating the effect of cognitive interventions on pain.

A minority of the subjects (only about one-third) explicitly reported employing, wholly or partially, the treatments they received in tolerating the cold water. This finding is in contrast to the greater extent of use of treatments indicated by subjects' report on the questionnaire, especially for the cognitive coping and sensation information treatments.

In most of the studies of this type, an assumption has been made that the subjects have used the treatments as instructed, or subjects have simply been asked whether or not they used the relevant techniques. A few studies have attempted to gather more information about the strategies the subjects actually used. Hackett and Horan (1980), for example, used written structured and unstructured questionnaires for this purpose, and they obtained results somewhat similar to those in this study. However, the limitations imposed by subjects' writing skills and motivation in using this technique were recognized, hence the use of the interview in this study. The interview results suggested that subjects' articulateness may have restricted the type of interview data obtained as well, although it probably afforded better information than a written questionnaire and was clearly superior to simply asking subjects whether they had performed as instructed.

If, in fact, the results of this study accurately reflect subjects' lack of implementation of treatments, then the implications for this and other studies of its kind are serious. That is, the outcomes which have been attributed to effects of treatments may in fact be due, to some significant degree, to subject-generated strategies instead.

However, before this conclusion can be drawn, a discussion is necessary of the issue of the suitability of subjects' self-report as a method of ascertaining the strategies or techniques employed in tolerating pain.

The interview results suggested that about one-third of the subjects gave vague, undetailed descriptions of their strategies, for example, stating that they just tried to take their minds off the pain, or that they "tried not to worry". A large number of subjects used techniques not referred to in the treatments, especially distraction. Consistent with the impressions of Leventhal and Everhart (1979), the conviction of the utility of distraction as a pain tolerance technique appeared to be very powerful among subjects. In fact, it was the experimenter's impression that a few of the subjects saw the treatment material as being an aid to distraction. That is, some subjects simply reflected on what they had heard, thinking it would help to "keep one's mind off the pain", instead of implementing the techniques as intended.

The apparent difficulty which subjects had in describing their thoughts and strategies raises the issue of how much access people actually have to their mental processes. Nisbett and Wilson (1977) have claimed that accurate self-report about thinking processes is not possible because one cannot be aware of one's own processes. Smith and Miller (1978) have tempered this argument somewhat by saying that the real issue is under what conditions people have such access. They stated that accurate self-report is possible when the individual is performing tasks which are engaging and not overlearned. Apparently access to mental processes about routine tasks is more limited. This is consistent with Vygotsky's (1962) findings that once speech has gone "underground", subsequent access interferes with functioning. If this is so, subjects who must tolerate acute pain would be assumed to have access to mental processes, in view of the engaging nature of the task. However, perhaps the task of tolerating pain in itself could interfere with such access. That is, it could be that when one's attention is almost entirely occupied with the task of tolerating pain, the individual would be less able to "observe" how he accomplishes this end.

Therefore, concluding that only a minority of subjects implemented the treatments is probably not warranted at this stage. The apparent low usage of the treatments was probably a reflection of an inadequate method of determining how subjects tolerated pain, due to variations in subjects' ability to recall and describe such processes and to perhaps limited access during a stressful experience. However, the interview technique is probably more productive than a written one. Suggestions as to how such methods could be improved are included in a subsequent section on implications for research.

C. Implications for Theory

The literature review indicated that a very wide variety of psychological methods are effective in modifying the experience of pain. The findings of this study offer some insight into the mechanisms underlying the impact of cognitive interventions on pain.

By way of a brief review, Leventhal has proposed that sensation information acts to reduce the emotional distress reaction by causing the individual to focus on the objective, informational components of pain. Conversely, he has claimed that greater pain is experienced when physical sensations are encoded in terms of emotional pain memories.

Meichenbaum, on the other hand, has stressed the conscious components of self-regulation in his approach to treatment. That is, approaches such as stress inoculation are aimed at changing people's self-talk and substituting more adaptive self-statements.

However, neither of the treatments based on the above approaches were more effective in this study than a placebo or a treatment designed to encourage emotional processing. These results suggest that the power of avoiding memories of emotional distress is not as great as Leventhal predicted, nor does instruction in adaptive self-talk affect pain differently than a purely informational treatment.

Two mechanisms are proposed which might account for the similarity of results among treatment groups. The first mechanism has to do with effects of the suggestion that the experience of pain could be altered, which was given all treatment subjects in the form of a statement to the effect that the treatments would be helpful to them in withstanding the cold stimulation. That is, the subject interprets the situation as being something he can deal with, rather than as something of which he is a victim. Second, the effects observed for all treatments may have been a matter of conscious appraisal. That is, the receipt of information related to the sensations to be experienced had the effect of "de-automatizing" the subjects' reactions to pain. In the same way that involuntary thoughts and acts are disrupted by making them voluntary, the individual's reactions to pain are changed. They are no longer habitual or automatic when a treatment brings about a conscious cognitive appraisal of the physical sensations, emotional reactions, and so forth.

Hence, the question must be asked whether the emphasis in future research ought to be on developing new types of cognitive interventions. Perhaps the research would have more applicability to clinical work if it focussed more on how changes in the individual's expectations and his cognitive appraisal can be most effectively accomplished.

D. Suggestions for Further Research

Based on information gained in the process of carrying out this study, and the research findings, a number of topics for further research are noted in this section.

1. The development of a more valid method of inducing pain for experimental purposes is recommended. In spite of the very widespread use of the cold pressor test as an analogue for clinical pain, this study has raised some questions about the validity of this procedure. In its favour, the cold pressor test does provide appropriate stimulation, that is, a rich array of sensations with

relatively slow onset, plus this method is convenient and safe. However, as a measure of pain tolerance, this procedure appears to be overly sensitive to extraneous factors surrounding the experimental situation and affecting motivation. Hence, it is difficult to define the extent to which the observed effects are due to the experimental treatments, making this a less than ideal method.

2. Development of additional measures of distress and discomfort in experimental situations, in addition to direct self-report, would be beneficial. For example, a questionnaire could be developed to measure the above constructs, such as an adaptation of the McGill Pain Questionnaire (Melzack & Torgerson, 1971; Melzack, 1975) for use in experimental settings.
3. In investigating the strategies employed by subjects to tolerate pain, two questions should be examined:
    a. Would an individual's access to his own mental processes by enhanced by specific training in observing and reporting how he accomplishes this task?
    b. Are techniques requiring self-observation and self-report about how one tolerates pain in fact suitable for use in stressful situations, in which attention tends to be focussed so much on the actual task of tolerating the stress and might not be available for appraisal of mental processes?

Two relatively new methods of gathering such information are noted here. First, having the subjects describe their strategies aloud as they accomplish a given task is a procedure described by Kazdin (1975). This technique is potentially too reactive, but warrants further investigation. Second, various methods of thought sampling have been reviewed by Kendall and Korgeski (1979) and some of them could be adapted in studies on cognitive intervention in pain.

4. The sensation information and cognitive coping skills approaches should be compared in a clinical setting. In addition, a treatment based on the encouragement of noting and exaggerating affect associated with pain seems to offer some potential, and it might be worthwhile to study it further, alone or in combination with treatments based on preparatory information or coping skills.
5. Because no direct evidence is available regarding the effects of repeated exposures to the cold pressor test on pain tolerance, this question should be investigated.
6. The effectiveness of the sensation information and cognitive coping approaches in reducing negative affect and increasing pain tolerance could be studied under varying threat conditions in an experimental situation.
7. It is suspected that most individuals already possess a number of skills to cope with pain, and perhaps a

critical step in enabling them to use these skills is to set the stage for them to interpret the situation as something they already know how to deal with. One way to investigate this question within a study on the effects of cognitive strategies on pain would be to include, in addition to a no-treatment control condition, a group which is encouraged to simply think about and covertly rehearse strategies they might use to increase pain tolerance. That is, these subjects would prepare their own strategies, without additional input from the experimenter.

The strategies employed by individuals who tolerate noxious stimulation well could be compared with those of subjects whose pain tolerance is low.

8. Another method of presenting treatments which would be worth investigating is having subjects listen to the treatment concurrent with the pain tolerance test.

E. Suggestions for Therapy.

Some potentially useful suggestions for practise which are based on the findings of this study are presented here.

1. The situational factors which surround a painful event and the psychological treatment aimed at modifying the pain appear to be almost as important as the particular treatment itself. Hence, a therapist who uses a treatment approach such as stress inoculation should recognize that it is the patient's perception and

interpretation of the problem which guides his coping processes.

2. The provision of accurate and authoritative information about procedures and sensations which can be anticipated seems to help the individual to focus on the relevant aspects of the situation he is to confront. In fact, simple and factual reassurances (for example, pointing out to the patient that the intensity of pain is not necessarily directly associated with injury) might function to encourage attention to the objective features of the sensations.

F. Summary of Research Findings

The findings of this study are summarized in this section.

On the dimensions of pain tolerance, distress, and discomfort, similar results were obtained for the three treatment groups and the placebo group. The sensation information, cognitive coping, and emotional processing groups and the placebo group all displayed greater pain tolerance than did the control group. Further, there were no differences in pain tolerance among the individual treatment and placebo groups.

Neither the sensation information nor the cognitive coping treatments produced results superior to a treatment designed to increase fearful expectancies and negative affect. In fact, a placebo treatment containing only information about reactions to cold, but no usable suggestions, was as effective as the other treatments. Apparently the effects of the treatments were not all that powerful. The differences between subjects receiving no treatment and those who did were probably due, at least partially, to situational factors affecting subjects' motivation.

None of the groups differed according to the amount of distress or discomfort they reported. Subjects' reported distress and discomfort were not affected by the treatments.

Subjects who reported that they thought the information they heard on the audiotape would be useful in helping them to tolerate pain obtained higher pain tolerance scores. They also reported less discomfort and distress following the cold pressor test. However, their expectations about a treatment's utility was not related to the extent to which they reported using it.

Apparently self-efficacy expectations had little to do with subjects' experience of pain in this study. s

The subjects tended to report that they had relatively few thoughts about possible injury to their hands during the cold pressor test. No single treatment was more effective in reducing these thoughts.

Regarding subjects' use of the treatments, the coping skills treatment was reported to have been used most, and the placebo and the emotional processing treatment least. The results of the interviews suggested low usage of treatments by subjects. However, this was probably not an accurate reflection of the actual implementation of treatments, due to probable difficulties in acquiring reliable retrospective self-report about mental processes.

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APPENDIX I: Introduction

First, thank you very much for participating in this study. As you may already be aware, this study is about psychological and physical reactions to cold temperatures and as a way of exploring this topic, we would like to find out how long you can keep your hand in some cold water. Please be assured that under these conditions, even ice-cold water cannot and will not cause any damage during the period of time you will be exposed to it. This procedure is completely safe and has been used many times by many researchers over the years.

Now I will describe in detail what you will be doing. First, you will listen to an audiotaped talk which will provide you with information which will help you to keep your hand in the cold water longer than you normally would be able to. After answering some questions, you will be instructed to place your right hand in the cold water so that your middle finger just touches the bottom of the pail and to keep it there until you feel you must take it out. You should try not to move your hand. I will keep track of the time, and you will also be asked some questions after placing your hand in the water.

Do you understand the instructions? Would you mind repeating them to me so we can both be sure we agree on what you will be doing?

Now pay close attention to the following talk because it will help you to keep your hand in the water. Here are the headphones. You can adjust the volume here. Please remove the headphones when the tape is finished.

APPENDIX II: Cognitive Coping Skills Treatment

I am going to tell you some things that you might find helpful in increasing your tolerance of this ice water, and of pain in general.

Research findings have demonstrated that what we think about something affects how we feel about it and how we act in the situation. For example, if you think too much about how awful or how painful a visit to the dentist will be, the situation becomes more painful and more unpleasant than it needs to be. Thinking is a lot like talking to ourselves; for example, at the dentist we might make statements to ourselves like "this is really going to hurt", and "I won't be able to stand it". The result of telling ourselves things like that is almost certainly going to be more pain, and a lot of tension. Once we become aware that we are saying such things to ourselves, we can then make changes in our thinking which will help to decrease our pain and distress, and help us to feel good about how we handle stress. That is what this talk is about: changing those unhelpful statements you make to yourself in order to better deal with a stressful situation; in this case, that of placing your hand in some ice-cold water.

When a stressful or unpleasant situation is encountered, many people tend to see it as a large and overwhelming event. Such a situation is much easier to cope with if it is broken down into smaller steps or stages. I am going to teach you how to break this stressful event into three stages, and how to tell yourself things which will help you to keep your hand in the cold water.

Here are the three stages. The first stage involves preparing for the stress or pain before it becomes strong. At this time, you are psyching yourself up, and getting ready to meet the challenge. This is a situation that you can do something about, and you are really paying attention to what you need to do. Let's suppose you are about to place your hand in the ice-cold water - some helpful statements you can say to yourself are: "What is it I have to do? I can develop a plan to deal with the cold I'm going to feel". "Sure, it's going to be cold, but I can handle it".

As time passes, you will find that the cold water causes more and more discomfort, and so the second stage of this process of coping is to confront and handle the pain as it becomes strong. At this point many people let their negative thinking interfere with their ability to cope - they might think that they can't stand it, and so on. If you find yourself thinking such unhelpful thoughts, and that's not unusual, that's your reminder to switch over to more positive, helpful thoughts. I'll illustrate some of the statements you can make to yourself at this stage: "One step at a time - think about what I have to do", "I'm feeling tense - that's my cue to take a deep breath, relax, and pay attention to what I have to do", "I knew it would be uncomfortable - I can handle it".

At certain times while your hand is in the cold water, or during any stressful situation for that matter, you will probably encounter what are called "critical moments". These are times when you notice that the intensity of the cold or the pain seems to be increasing rapidly, or you start thinking you cannot go on any longer. These moments will come and go - its like jumping hurdles. Once you are over one obstacle, the pain will decrease, and then increase again. Handling these times is the third stage of the coping process. Some helpful statements you might make to yourself at these times are: "I knew the pain would increase - I can just hang in there until it subsides", "I don't have to get rid of the pain altogether, just keep it manageable", and "I'll just tell myself I can stay in a bit longer".

There's one more important thing you can do during all three stages of coping, and that is to reflect on and evaluate your performance. You've probably noticed that people often criticize themselves, but they rarely praise their behavior. If you are doing well, you should give yourself a pat on the back; you might say, for instance, "That's it. I know what to do to cope with this cold." "I knew I could handle it - I'm doing pretty well". " I got over that hurdle pretty well". If you think you should be doing better, you can use that as a cue to try something different, or to think of other things to say to yourself to help you to cope better. This will help a lot to encourage you to continue with the task.

Now I will summarize what has been said so far. What we tell ourselves about a stressful or painful situation can influence how we react to it. If you tell yourself a lot of negative things, you probably won't be able to stick with it, and cope, for very long. The two main things that will help you to cope are: first, breaking the situation down into smaller, manageable steps, and second, telling yourself positive and realistic statements.

Now I would like you to think of some positive and helpful statements that you can use while your hand is in the cold water. I will name each stage and then pause - during that pause, think of some helpful statements to say to yourself, and be sure to reward yourself at each stage, as well. Now imagine you are looking at the ice water; you are about to put your hand into it. This is the first stage, when you are getting ready to meet the challenge, psyching yourself up. Think. What will you tell yourself at this stage? (Pause - 25 seconds.) Now the second stage - the cold is becoming uncomfortable. Think again. What statements will you make to yourself? (Pause - 25 seconds.) Now the third stage. You are encountering a critical moment - the pain is quite strong, and you are beginning to consider pulling your hand out. What can you say to yourself to get over this hurdle? (Pause - 20 seconds.)

That's the end of this talk. Now the experimenter will ask you a few questions, and then you will be asked to place your hand in the cold water. I would encourage you to use the techniques that have been discussed. Keep your hand in the cold water until you feel you must take it out. Psych yourself up to the best effort. Again, thank you for your help in completing this study. Please remove the headphones.

APPENDIX III: Sensation Information Treatment

This talk is about physical sensations. When we use the term sensation, it usually means something that we are aware of, that we pay attention to, that happens as a result of one of our senses being stimulated by something. We are all familiar of the sensation of pricking a finger with a pin, for example, or of hearing the strings of a guitar being plucked. And we experience a sensation of cold when our hands are placed in water that has ice in it.

In a few minutes, I am going to tell you in detail what kinds of sensations you can expect when you place your hand in the cold water. You may find this information helpful to you.

First, though, I am going to read some words which a number of people have used to describe strong physical sensations - sensations they have experienced in a variety of situations, not just having contact with cold water. Here is the list of words.

flickering
throbbing
quivering
beating
pulsing
jumping
flashing
shooting

pulling
hot
tingling
itchy
dull
heavy
taut
spreading

continuous
rhythmic
brief
steady
periodic
momentary
thumping
darting

tight
stretching
knotting
nipping
tweaking
rubbing
tickling
keen

pricking
sharp
pinching
pressing
cramping
tugging
cold
radiating
penetrating
tight
drawing
squeezing
cool
flaring
binding
blurred
numb
concentrated
biting
warm
vivid
blunt
stinging
chilly
bright
glowing

You can see there are many words for describing sensations.

"The cold temperature treatment that I mentioned will involve submerging your hand, to above the wrist, in an ice-cold bath." (Leventhal et al., 1979, p. 693) Now I will tell you in more detail what kinds of sensations you can expect. "When you put your hand in the water, the first sensation will be one of extreme coldness. The feeling of coldness will last for a short period of time (perhaps 20 to 30 seconds), and then you will begin to feel a number of different sensations.... Along with this, you will begin to get a feeling of strong pressure on your hand. You may notice that the feeling of discomfort is not spread evenly around your hand but rather is concentrated in certain areas. For instance, you may begin to feel a tingling sensation in your fingers which seems to bite or burn. Your whole hand may throb after some additional time, and the joints of your fingers will begin to feel somewhat stiff.

After a while, the strong sensations will begin to fade. At this time you will feel a pinpricking sensation or a feeling that your skin is being pulled tightly across the back of your hand. This sensation will fade in your lower fingers and lower hand until you can feel only numbness. The prickly feeling will remain only in a ring at the point where your hand enters the water." (Leventhal et al., 1979, p. 693). You may find that these sensations come and go.

This cold temperature treatment produces many feelings and reactions in addition to the sensations you will feel in your hand.

When you first put your hand in the water, you will feel a sense of apprehension or anticipation. Almost immediately your whole body will begin to react to the temperature change.... You'll also be aware of additional feelings and reactions. Some of these will be similar to those feelings you have when you are experiencing an emotion such as fear or excitement. You may even be experiencing some of these reactions right now, such as butterflies in the stomach. You may notice that your other hand has begun to sweat. Along with this, you will feel yourself becoming more alert or awake. Generally, you will feel your whole body is exerting a great deal of effort. Your facial muscles, in particular, will show an increase in tension. You might feel your forehead raise and wrinkle. Tension will sometimes spread to other parts of your body - your arms, shoulders, and chest. After a while, this muscle tension may cause a feeling of weakness in various joints and muscles in the legs and chest. After a while your emotional reactions and your feelings of tension will begin to fade." (Leventhal et al., 1979, p. 693).

That is the end of this talk. Now you will be asked a few questions, and then you will be asked to place your hand in the cold water. Keep your hand in the cold water until you feel you must take it out. Again, thank you for your help in completing this study. Please remove the headphones.

APPENDIX IV: Emotional Processing Treatment

I am going to talk about how our emotions affect the amount of pain we feel and how you can use this information to help yourself during the task you're asked to do. Our minds and bodies do not act independently. It used to be thought that pain was just a sensory experience - pretty much like hearing or tasting. However, we now know that pain is much more complicated than that. Our emotions are very closely bound up with our physical sensing of pain. Right now, I would like you to recall a time when you experienced a great deal of physical pain, perhaps an accident, or a bad toothache. (Few seconds' pause.) Did the pain demand almost all of your attention? It probably interrupted what you would usually be doing, and you were probably very motivated to find a way to stop that pain. And do you remember the frustration, the anxiety, and perhaps the fear that went along with the pain? As you can see, pain is much more complicated than most people realize.

We know that pain is almost always accompanied by anxiety, upset feelings, and muscular tension. The more anxiety and upset we feel, the more pain we will experience. For example, perhaps you've noticed that when the dentist is working on your teeth, you feel much more pain and discomfort, and the pain lasts longer, when you feel scared and upset.

If feeling anxious, scared, and upset makes pain worse, how can we lessen the pain we feel and get rid of tension too? You can decrease your pain a great deal by discharging your emotions, by expressing what you are feeling, by just letting go of those negative emotions. As we've already talked about, suppressing those feelings will only increase the pain and make you very tense, which in turn will make the pain even worse.

A number of studies have shown that discharging anxiety and distress reduces tension - people who have expressed their pent-up emotions show a lower heart rate, less muscular tension, and say they feel more relaxed.

I will tell you in a few minutes how you can best deal with the pain you are going to feel while your hand is in the cold water. But first, I would like you to again recall the time you experienced a great deal of physical pain. Remember how it felt and the emotions and upset that went with it. (Brief pause.) Now here are some words that other people have used to describe intense pain and the feelings that went along with those experiences. Think about whether these words also describe your experience.

burning
pounding
stabbing
boring
drilling
lancinating
sickening
suffocating
crushing
gnawing
wrenching
scalding
cruel
vicious
killing
wretched
blinding
horrible
anxiety
anguish
torture
misery
distress
suffering

lacerating
cutting
sore
hurting
rasping
splitting
exhausting
unendurable
searing
stinging
fearful
frightful
terrifying
punishing
gruelling
smarting
excruciating
unbearable
miserable
troublesome
torment
grief
racking
spasm
stitch
migraine
agonize
writhing
cringe
intolerable

You can see that there are many ways to describe pain and the feelings that go with it.

Now to prepare for the task that you are about to do. You will find the water very cold at first, and soon you will experience a sensation of pain which will become very strong. At the same time, you may be feeling fearful, with lots of tension in your shoulders, arms, back, and face. Your task is to keep your hand in the water as long as you can, so of course you will want to decrease the pain as much as possible.

As I already talked about, the best way to decrease the pain is to get rid of those negative, scary feelings you will have. And the best way to do that is to openly express those feelings - really let them out. How to do that? You can grimace and make faces. You can talk about your feelings - about feeling scared, mad. You can swear, or moan and groan. Remember, suppressing your feelings, keeping them bottled up inside, will make the pain worse and you'll feel even more tense and more upset, and you would soon find that you must give up - you could not continue to contain all that emotion and tension, and the pain would become unbearable.

In order to let your feelings out, and not let them build up, you must of course stay in contact with what you're feeling. It will not help you to try to ignore your pain or your upset feelings or your tension - they will rapidly grow and build up anyway.

It is far more productive to simply get rid of your feelings as they arise, and so keep your pain at a minimum.

There is one more thing to do to prepare yourself for placing your hand in the cold water. I would like you to sit quietly now for a short while and imagine this scene as clearly as you can: you are placing your hand in the cold water, and you are finding it painful, and many feelings are welling up inside you. At the same time, think of ways you can let out those negative, scary feelings that are worsening your pain. Try out, in your mind, for example, wailing, moaning, and grimacing. I will now pause so you can think about what to do. (Pause - 25 seconds.)

That's the end of this talk. Now you will be asked a few questions, and then you will be asked to place your hand in the cold water. I would encourage you to use the techniques that have been discussed. Keep your hand in the cold water until you feel you must take it out. Psych yourself up to the best effort. Again, thank you for your help in completing this study. Please remove the headphones.

APPENDIX V: Placebo

Despite the wide swings of temperature in the water and air around us, our body temperature changes surprisingly little. A human being can endure small deviation from the norm and functions really well only when his temperature remains within the narrow range of 97 degrees F. to 102 degrees F.

In terms of life and death, warm-blooded creatures though we are, we can endure far less heat than cold. Let the temperature rise a mere 6.4 degrees above normal - 106 degrees F. on a thermometer - and there is danger of heat stroke and death. On the other hand, the body can recover from chilling to temperatures many times farther removed from the norm...up to twenty degrees or more below normal.....On the average, women resist freezing better than men do because of an extra layer of advantageously distributed fat beneath the skin.

As quite a number of survivors of accidental freezing have been drunk, the question naturally arises whether the alcohol level in the blood plays a role in improving resistance to cold. Alcoholic rats were put into a state of profound hypothermia by researchers...Their hearts continued to function at temperatures which had stopped the hearts of a control group of nonalcoholic rats. When rewarmed, the hearts of the drunken rats resumed beating before those of the sober animals. Experiments performed on dogs indicate that alcohol consumption cuts down the risk of irregular heart action. Much more research in this area is needed, however. The fact that many drunken people survive freezing may simply be due to the fact that drunks are more likely than sober people to be accidentally frozen in the first place. Lying down on an icy street is hardly a considered action.

The exposure to cold is a great challenge to be faced by the body....It calls forth a coordinated life-saving response, which was named by W. B. Cannon, one of the pioneers in temperature research, "the fight or flight reaction." The body fights to retain its warm-blooded state, and the metabolism rises to meet the challenge and produce more heat.

The fight reaction is ruled by the hypothalamus, a tiny bit of brain tissue that lies beneath the thalamus at the base of the midbrain and that also controls appetite, water balance, and sympathetic nervous system activities. This is the body's thermostat. The posterior portion of the hypothalamus controls cold and the anterior heat.

When a person goes outside on a cold day or plunges into an icy sea, his skin, which is in contact with the air or water, is naturally the first place to feel the cold and respond to it. Discomfort is registered in specific spots or receptors that react either to cold or to heat. The cold receptors are more numerous and closer to the surface than are those for heat. Sudden extreme cold stimulates these spots to frenzied activity and they send out a whole burst of warning impulses before adapting to the change. The sensation of cold is, therefore, rapidly lost when one goes swimming in chill ocean or lake waters, but the message has by then been passed along anyway.

The first physiological response to the stimulus of cold takes place in the blood vessels in the skin. They constrict, so that less blood can flow to the surface and be chilled. The skin thus acts almost like an outer garment, insulating the inner portions of the body. The warm blood is concentrated in the internal organs and their temperature may even rise slightly.

The hypothalamus, which has received the nerve impulses set off by the skin receptors, activates the sympathetic nervous system. And just as in the comparable situations of terror or fury, the heart pumps faster and the glands secrete additional quantities of adrenalin and other stimulating hormones. The expression "hot with rage" is literally true; the metabolism rises. And heat is the main by-product of metabolism.

When the stimulation reaches the skeletal muscles, the most effective of man's defenses against cold is activated: the muscles begin an involuntary, uncoordinated shivering that varies in intensity with the cold. This is remarkably effective in raising the body's metabolic rate. When a person is slightly chilled, the shivering is only a tremor and increases the amount of warmth being produced in the body by twenty to twenty-five percent. In severe cold it consists of violent spasms and the results in terms of internal heat production are startling. The increase is four hundred percent.

Yet shivering is not enough. It is perfectly apparent to anyone who has ever remained out in bitter weather for any length of time that shivering does not really make him feel warm. Guides on mountain-climbing expeditions advise novices not to wait to feel cold before putting on protective clothing. They have observed at first hand that the body heat is not restored. Shivering will prevent any further heat loss and will save one from freezing to death - provided, of course, that the exposure is not too prolonged or extreme. But the most violent spasms the body can produce will not replace one iota of the warmth already lost. And particularly if the chilling is gradual, warmth is lost before shivering starts.....Sometimes, when the chilling is rapid, the shivering may come even before it is really needed. Healthy people have been known to start shivering from cold with a temperature of 100.6 degrees F. Their skin temperature had dropped, and this was stimulus enough. On the other hand, shivering often ends long before the chilled person warms up. He finally returns to his snug house and throws off his coat. His shivering stops, even though body heat is still far below normal. Nonetheless, he continues to get warmer without any further spasms. (Kaveler, 1970, pp. 26-30)

That is the end of this talk. Now you will be asked a few questions, and then you will be asked to place your hand in the cold water. Keep your hand in the cold water until you feel you must take it out. Again, thank you for your help in completing this study. Please remove the headphones.

APPENDIX VI: Self-report Questionnaire

All of the following items were administered to subjects in the three treatment groups.

Following each item is a notation indicating whether it was answered by control subjects following the first cold pressor trial, or after hearing the placebo treatment.

1. Indicate how useful you think the information you heard on the tape will be in helping you to keep your hand in the cold water. (1 - not useful, 7 - very useful) Post placebo.
2. Indicate how confident you are in your own ability to keep your hand in the cold water. (1 - not confident, 7 - very confident) Post placebo.
3. Indicate the intensity of the physical discomfort you experienced while your hand was in the cold water. (1 - very low, 7 - very high) After first cold pressor.
4. Indicate the amount of upset and emotional distress you experienced while your hand was in the cold water. (1 - very low, 7 - very high) After first cold pressor.
5. Indicate the extent of your agreement or disagreement with this statement: The audiotape was helpful to me in keeping my hand in the cold water. (1 - strongly disagree, 7 - strongly agree) Post placebo.
6. Did you use what you learned from the taped talk while your hand was in the cold water? (1 - not at all,

7 - all of the time) Post placebo.

7. While your hand was in the cold water, how often did you think that your hand might be in danger of injury? (1 - not at all, 7 - all of the time) Post placebo.
8. Generally speaking, how sensitive are you to pain? (1 - very little sensitivity to pain, 7 - very sensitive) Post placebo.

APPENDIX VII: Interview

1. I'd like to capture what you were thinking while your hand was in the water. What were you saying to yourself? At the beginning? After a short time? Just before you took your hand out of the water? Did you have any other thoughts?
2. What did you do to help yourself to keep your hand in the cold water? Any strategies or tricks?
3. What made you want to keep your hand in the water?